Exercises 4 (Interpretation)

4A. *(SVM interpreter)*

Consider the SVM interpreter outlined in the course notes (starting at slide 4-13). Show how to modify this interpreter to detect the following failure conditions, updating the status register accordingly:

(a) division by zero;

(b) invalid data address (e.g., in a load/store instruction);

(c) invalid code address (e.g., in a jump instruction).

4B. *(Mini-Basic VM)*

Consider a very simple language, mini-Basic, that has the following syntax:

prog = *com* $^{+}$

com = ‘`set`’ *var* ‘`=`’ *expr*
| ‘`read`’ *var*
| ‘`write`’ *expr*
| ‘`goto`’ *com-number*
| ‘`if`’ *expr* (‘`=`’ | ‘`<`’ | ‘`>`’) *expr* ‘`goto`’ *com-number*
| ‘`stop`’

The commands of a program are automatically numbered 0, 1, 2, … These command numbers are used as the targets of `goto` commands. There are just 26 variables, named `a`, `b`, …, `z`. Their values are floating-point numbers. Here is an example of a mini-Basic program:

```
0: read a
1: read b
2: if a<b goto 5
3: m = a
4: goto 6
5: m = b
6: write m
7: stop
```

(a) Design a mini-Basic virtual machine. It must include a code store that contains one command per cell.

(b) Suggest *three* different ways of representing commands in the code store. What are the advantages and disadvantages of each representation?

Exercises 5 (Compilation)

5A. *(Fun compiler)*

Consider the Fun compiler outlined in the course notes (starting at slide 5-9), and the following Fun source program:

```
int m = 10
proc main ():
  # Read an integer n and
  # write the minimum of n and 10.
  int n = read()
  if n < m:
    m = n .
  write(m)
  # Done!
.
```

(a) Show the AST that should result from syntactic analysis of this source program.

(b) On the AST, show the types that should result from contextual analysis.

5B. *(Fun compiler – error detection)*

The Fun source program below contains scope and type errors:

```
int n = 0
proc main ():
  while n :
    n = (n<1) .
  x = n .
```

(a) Show the AST resulting from syntactic analysis of this source program.

(b) Using the AST, show how contextual analysis will detect the errors.